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SG Undersea Cable System:

Introduction and Development Plan

By R. D. EHRBAR, A. E. FORD, and G. GERBIER

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This paper describes the background of the three-nation SG development and the structure of the organization, and comments on the success with which the mission was carried out.

I. INTRODUCTION

Communications traffic across the North Atlantic has increased around 20 percent per annum for some years, carried partly by cable and partly by satellite. This growth continued beyond 1970, following the start of service on the then-newest undersea cable facility, an SF system called TAT-5, in March of that year.[1] There was no reason to think that the growth rate would fall significantly in the next decade. Satellites were carrying a significant part of the North Atlantic traffic, and it was generally recognized that both cable and satellite technologies should be carried forward to their maximum potential. This provided the impetus for pursuing the new cable technology designated SG.

In this paper, we do not discuss the merits of the different transmission technologies or predict future deployment. Instead, we devote our attention to the development of the SG undersea cable system, which as

TAT-6 (3400 nmi long) was turned up for initial service on July 27, 1976 between the United States and France.

II. NEW DEVELOPMENT PLANS

An exploratory program was under way at Bell Laboratories, even before the completion of TAT-5, to determine practical objectives for the next undersea system that would logically follow SF and would continue the reduction in cost per channel mile. In the United Kingdom, production of a system with a top frequency of 14 MHz was also under way. This system, developed for short distance cables, was capable of providing a nominal voice capacity of 1840 two-way channels spaced at 3 kHz. Ongoing development to extend the system to intercontinental distances was well advanced.

A tentative plan for deployment of cables in the North Atlantic had been formulated in negotiations among the many parties sharing responsibility for these communications. One plan called for another SF system between the U.S. and France in 1973, and then a new large capacity system (perhaps as many as 4000 channels) from the U.S. to the U.K. at a later date. To further this plan, two projects were set in motion in 1970: (*i*) Application was made to the American Federal Communications Commission (FCC) in August for permission to lay an SF system from the United States to France and (*ii*) plans were formulated within the Bell System for the development of a new, higher capacity system to be called SG.

The FCC ruled against the SF system in mid-1971 as not being in the public interest and recommended that the development of the proposed SG system be expedited so as to be ready for service as rapidly as possible. This put considerable pressure on completing the SG development so that manufacture could be started at an early date, since there was likely to be a cable circuit deficit across the Atlantic between 1973 and the earliest time considered practical for completion of a transatlantic SG (about 1976).

The pressure to provide another transatlantic system at an earlier date was reduced significantly by a decision of the British Post Office (BPO) and the Canadian Overseas Telecommunications Corporation (now Teleglobe, Canada) to install CANTAT-2, producing 1840 3-kHz message channels between Widemouth, Cornwall and Halifax, Nova Scotia.[2] This link was brought into service in 1974.

III. SHARED DEVELOPMENT PLAN

The idea of a shared development approach to the new SG system had been considered in the early planning stage, and the first joint meeting of AT&T, Bell Laboratories, and the BPO was held in June 1970 in London. In view of the development work already being undertaken by

both the BPO and Bell Labs, partnership in the development of the SG system seemed natural. The division of the development work was changed several times. Only two decisions made at the early meetings remained constant: (*i*) Bell System responsibility for repeater development and (*ii*) BPO responsibility for a new 1.7-in. cable development. Originally, it was intended that the BPO would be responsible for the development of the terminal transmission equipment, but in a three-party agreement, the French Ministry for Postes and Telecommunications (FPTT) accepted responsibility for this work. This was a logical step since, by 1971, it had been internationally agreed that the new, high-capacity system TAT-6 would be installed between Green Hill, Rhode Island and St. Hilaire de Riez, France.

IV. DIVISION OF RESPONSIBILITY

While the division of responsibility could not be completely specified, an attempt was made to define it in some detail. Some responsibilities were common to all, while others were assigned to individual groups.

4.1 Common responsibilities

These can be summarized as follows: Development of overall system design parameters and specification, system planning principles and engineering, specification of test equipment and procedures for installation, commissioning, and maintenance of the system.

4.2 Individual responsibilities

AT&T (Bell Laboratories) was given the development responsibility for the following portions of the system: repeaters and devices for repeaters, repeater factory test sets, laying test sets, couplings and junction boxes, ocean-block equalizers, supervisory tone and repeater monitoring test set, shipboard and shore high-voltage power-feeding equipment, and order wire equipments for cable laying and burying.

BPO was given the development responsibility for cable, jointing methods, cable handling procedures, cable fault location test sets, cable factory test sets, and other associated test equipment.

The FPTT was given the development responsibility for the terminal transmission equipment (multiplex and wide-band line) between the supergroup distribution point and the transmission equipment side of the power separating filter, the order wire and associated terminal signaling equipment, and maintenance test sets.

4.3 Formal agreement

Arrangements were formalized in a document titled "Agreement for Shared Development of a High Capacity Submarine Cable System"

signed on May 2, 1973 although, by mutual agreement, work had started in 1971. The document contained descriptions of the various responsibilities, a method for distribution of development costs, means for handling technical information and inventions, and a list of tentative objectives for system characteristics.

V. PROJECT ORGANIZATION

An undersea cable system is a complex transmission system design consisting of many parts and processes, as is shown in the companion articles in this issue. Each part must have individual objectives, and the complete system must function to produce an end result that is both economical and reliable.

For these reasons, a relatively complex organization was required to guide and monitor the joint development work by technical representatives of the three countries working together for a common goal. Overall guidance was provided by a Development Steering Committee (DSC) consisting of two members each from the BPO, FPTT, and AT&T-BTL. The detailed work was carried out by seven working parties, each having from 8 to 10 members.

A second agreement titled "TAT-6 (SG) Cable Construction and Maintenance Agreement" was a vital part of the project. This agreement assumed the use of the SG system for TAT-6 and defined ownership interest, assignment of channels, responsibility for procurement, installation, etc. of this first SG link to be installed. It was signed by the appropriate telecommunications agency in 16 European countries plus AT&T, ITT Worldcom, RCA Globcom, and Western Union International. From this agreement, the TAT-6 General Committee was formed. A subcommittee, responsible for procurement and installation, was the main point of contact with the SG Development Steering Committee.

VI. METHOD OF OPERATION

Meetings of the development working parties were scheduled as required, and the location of the meetings was rotated among the three countries. Prior to each meeting of the Development Steering Committee, reports of the working parties were circulated for review. The report of each DSC meeting consisted of general discussion and agreements and the following specific sections for control of the project:

(*i*) Review of memoranda from the TAT-6 subcommittee B and memoranda to that subcommittee covering outstanding points.
(*ii*) Review of working party chairmen's reports and instructions to working parties.
(*iii*) Report to administrations.
(*iv*) Review and allocation of development costs.

VII. RESULTS

While the joint development seemed to be overly complex at times and introduced the added expense of traveling, it was a successful endeavor. The interchange of technical information contributed to the development of the SG system and was valuable to each organization for its future work.

The technical results of the development program are discussed in the succeeding papers. The decision to install a 3400-nmi transatlantic system as the first project was rather daring. Laying cable in the North Atlantic early in the year proved to be a hazardous adventure, as the weather refused to be cooperative and accounted for considerable delay and apprehension. Many last-minute decisions were required, but nevertheless, except for the fact that the system objective for intermodulation noise was not fully met, the project was successfully accomplished.

The causes of the intermodulation noise have since been established and development work actively pursued to eliminate these problems, both in future SG systems and by the use of special equipment at one terminal of TAT-6. Bell Laboratories intends to continue to improve the cost effectiveness of the system, and it is hoped that future cable system requirements can take advantage of the facility successfully developed as a result of this unique international cooperation.

REFERENCES

1. "SF Submarine Cable System," B.S.T.J. *49*, No. 5 (May–June 1970), pp. 601–889.
2. "CANTAT-2 Submarine Cable System," Post Off. Elec. Eng. J., *67*, Part 3 (October 1974).